23. Melampus fasciatus, Desh.

From the same islands as the preceding.

24. Melampus caffer, Küst.

From Mahé.

25. Melampus bridgesii, Carp.

From Mahé. Under damp stones, close to the sea; extremely local, I only found it at one spot.

26. Plecotrema, n. sp.?

From Mahé. Under the stones of an old jetty at Port Victoria; rare.

27. Neritina gagates, Récl.

From Praslin. In a very small rapid stream, close to where one crosses to go to Curieuse; very local.

28. Melania (Melanoides) tuberculata, Müll.

From Mahé, Praslin, and Silhouette.

29. Pyrazus palustris, Linn.

From a creek at Mahé, near Port Victoria.

30. Paludomus ajanensis, Morl.

From a rapid stream, rather high up, at Mahé; rarely collected.

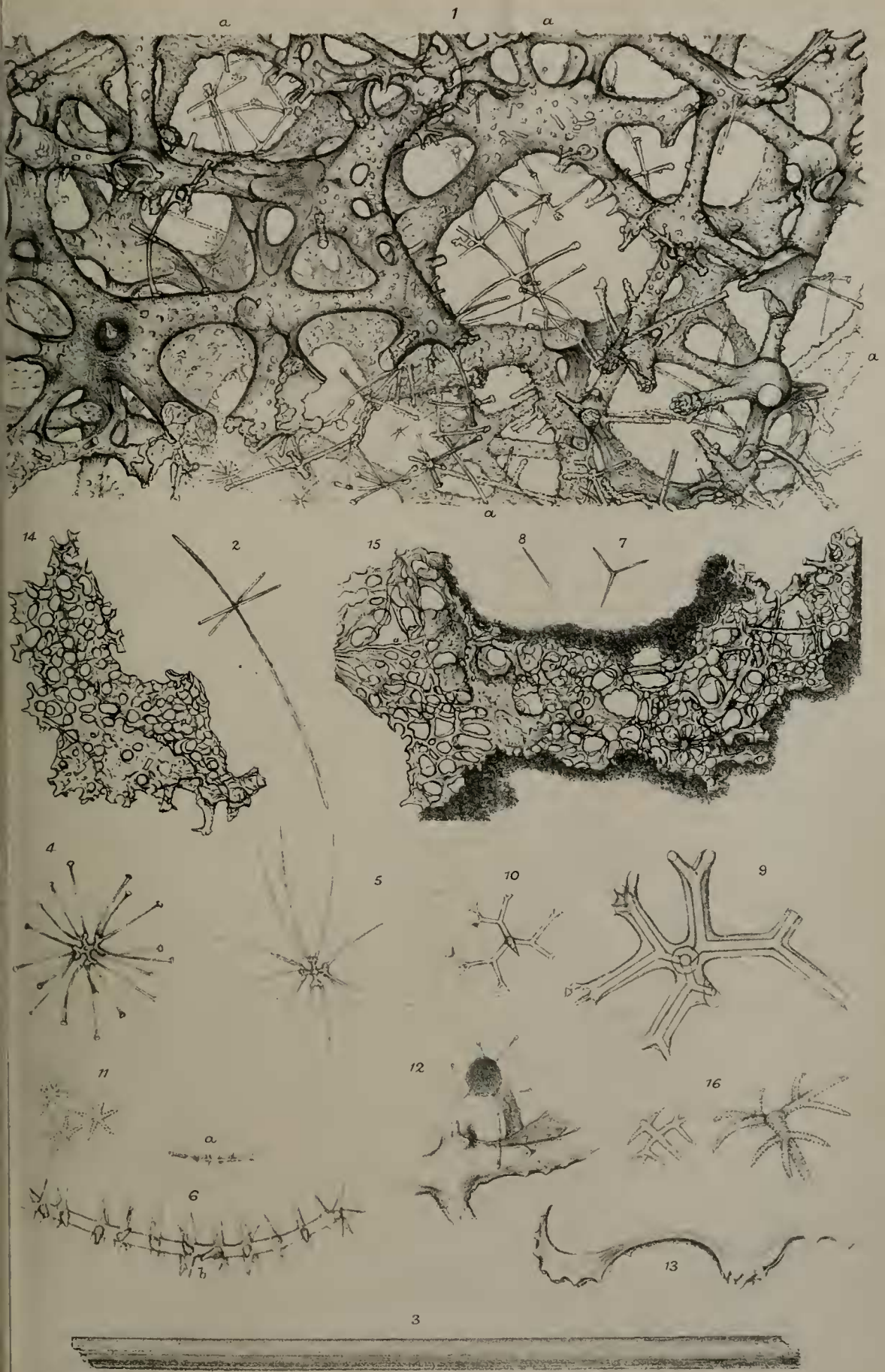
31. Paludomus, n. sp.?

From Silhouette. Very rare; in a small stream, very high up.

3. A Monograph of the Siliceo-fibrous Sponges. By J. S. Bowerbank, LL.D., F.R.S., F.Z.S., &c.—Part I.

(Plates III., IV., V., & VI.)

In my observations on Dr. Gray's "Notes on the Arrangement of Sponges," published in the 'Proceedings' of this Society for 1868 (pp. 124 & 125), I have stated my objection to his arrangement of the siliceo-fibrous sponges, several species of which he has named and described in the volumes of the 'Proceedings.' His descriptions are very brief, and are mainly dependent on the characters of external form and the peculiarities of their surface; but although describing them as sponges, he appears to be still in a state of uncertainty regarding their real nature. In his descriptions of his genera *MacAndrewia* and *Myliusia* (Proc. Zool. Soc. 1859, p. 437), throughout the whole of the paper, he expresses doubts of their spongeous nature, and inclines to the belief, in p. 440, that they, with *Dactylocalyx*, might "all prove to be a peculiar family of



Lens Aldous del et lith.

W West imp

Siliceo-fibrous Sponges.

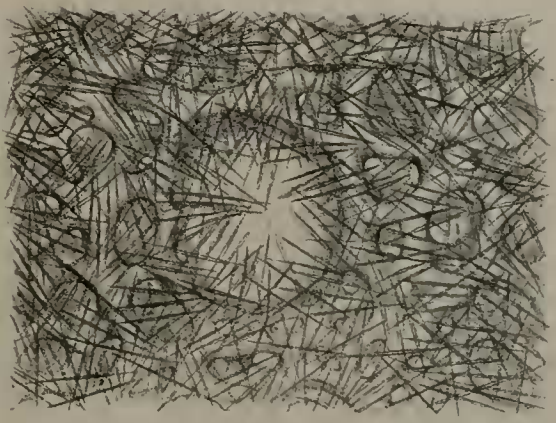
1

2

3

4

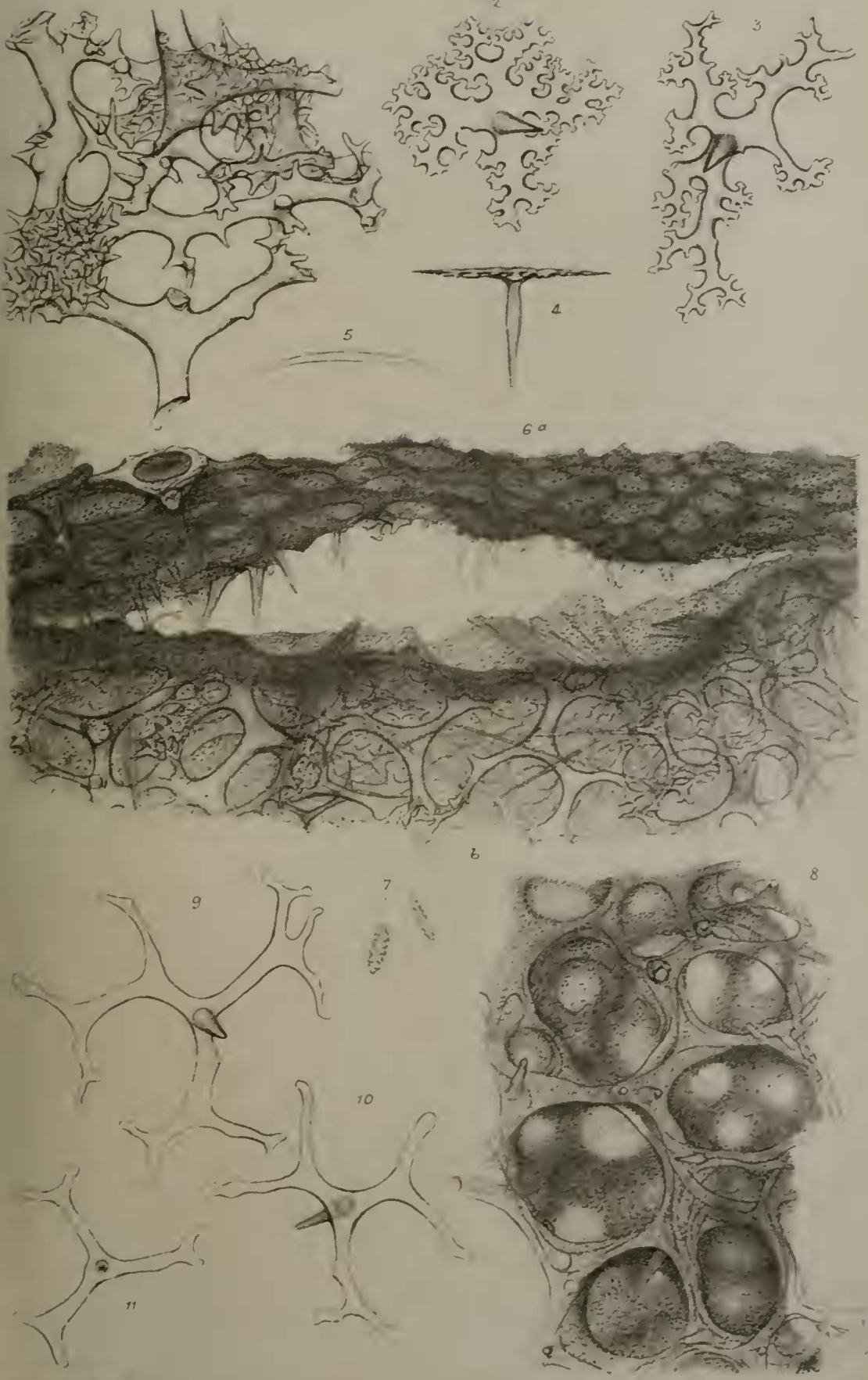
5



ens Aldous del et lith.

W West imp.

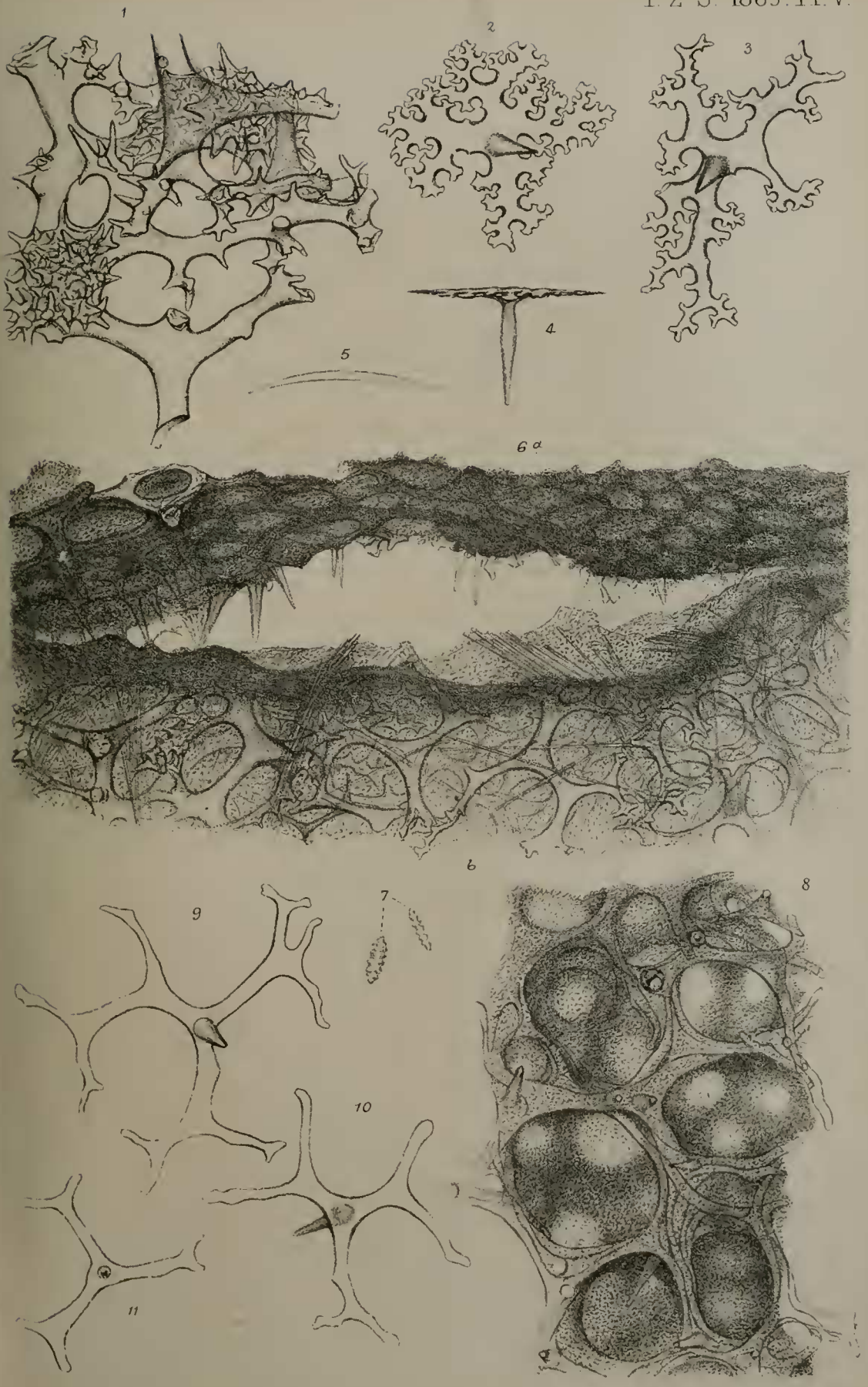
Siliceo-fibrous Sponges.



Lens Adams del et lith.

Siliceo-fibrous Sponges

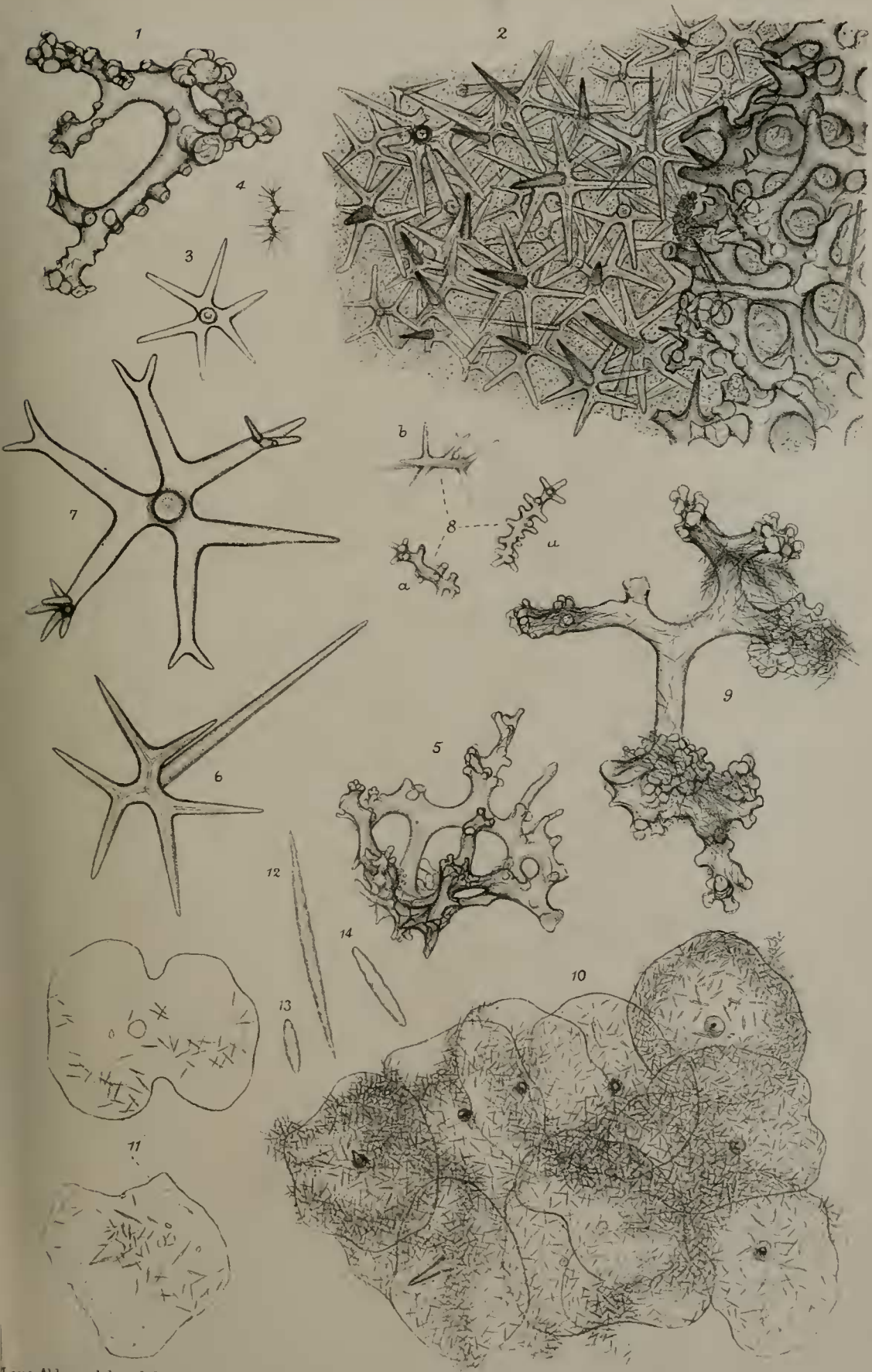
W West imp



Lons. Aldous del. et lith.

Siliceo-fibrous Sponges.

W West imp.



Lens Aldous del. et lith.

Siliceo-fibrous Sponges.

W. West imp

zoophytes rather than sponges." In his "Notes on the Arrangement of Sponges (Proc. Zool. Soc. 1867, p. 492) he arranges them as sponges; but in his description of his genus *MacAndrewia* he commences thus:—"The coral expanded, cyathiform," &c. This confusion of ideas can only be accounted for on the supposition that Dr. Gray has really never taken the trouble to ascertain the structural characters of the specimens that have been so many years in his possession.

Although differing to a considerable extent from the general mass of the *Spongiadæ*, the primary design of sponge-life in the siliceo-fibrous species is in perfect accordance with the great mass of the sponges. The external and internal defensive systems are as those of other sponges, and their minute organs, as in other species, are exceedingly various in form and strikingly demonstrative of their specific characters; in truth they possess in perfection every essential organ of the *Spongiadæ*.

Dr. Gray, in his "Notes on the Arrangement of Sponges" (Proc. Zool. Soc. 1867, p. 505), has formed an order to receive the siliceo-fibrous sponges, which he has designated Coralliospongia, and he thus defines the members of his order:—"Sponge hard, coral-like. Skeleton entirely formed of siliceous spicules, anchylosed together by siliceous matter, forming a netted mass covered with sarcode." Prof. Wyville Thomson, in the 'Ann. & Mag. Nat. Hist.' for February 1868, p. 120, in describing the siliceo-fibrous sponges, under the head of the "siliceous skeleton," says:—"In *Habrodictyon* [*Alcyoncellum speciosum*, Quoy et Gaimard] and *Hyalonema* the skeleton is composed entirely of separate siliceous spicules of various forms, interwoven in fascicles and connected by the thin sarcode layer, or scattered irregularly among the fascicles of spicules. In *Euplectella*, *Aphrocallistes*, *Dactylocalyx*, and *Farrea*, certain kinds of these spicules are more or less completely fused together, forming a continuous anastomosing network."

In my observations on Dr. Gray's "Notes on the Arrangement of Sponges" (Proc. Zool. Soc. 1868, p. 118), I have already pointed out the error the author has fallen into in describing *Dactylocalyx* as "entirely composed of siliceous spicules anchylosed together by siliceous matter into a network;" and I have there stated, and have not since seen reason to alter my conviction, that the description of Dr. Gray is eminently incorrect, as no one, "I believe, ever saw the terminations of spicula united into a network through the morbid action of anchylosis by means of siliceous matter;" and I may add that I have never yet seen a case of the anastomosis of spicula. The normal condition of these organs is never to anastomose, however closely they may be packed together, while that of siliceo-fibrous structure is always to anastomose when they touch each other; and this law is abundantly illustrated in the fibrous structure of the skeleton of *Euplectella aspergillum*, Owen, now so common a specimen in the cabinets of collectors. This error of Dr. Gray, regarding the spicular structure of *Dactylocalyx* and other siliceo-fibrous sponges, seems to have been unhesitatingly adopted by Prof. Wyville Thomson, and without any

effort to test its accuracy, as it appears to me to be impossible that the fibres of *Dactylocalyx pumiceus* should be seen beneath a microscopical power of about one or two hundred linear without the conviction being immediately arrived at that the tissue was purely fibrous; and sections at right angles to their axes at once exhibit their concentric structure, and prove that they are not compound structures formed of "separate siliceous spicules of various forms, interwoven in fascicles." This description, quoted from Prof. W. Thomson's paper (Ann. & Mag. Nat. Hist., Feb. 1868, p. 120), will apply correctly enough to *Hyalonema*, but certainly not to "*Euplectella*, Owen, *Aphrocallistes*, *Dactylocalyx*, and *Farrea*," the latter four genera having purely siliceo-fibrous skeletons, while *Hyalonema* is as purely a spiculo-reticulate structure.

Prof. Wyville Thomson, in his paper in the 'Ann. & Mag. Nat. Hist.' for Feb. 1868, has proposed a new name for the siliceo-fibrous sponges; but a new name, unless it be more significant than the old one, is a detriment rather than an advantage to science. He designates them as vitreous sponges; this is an erroneous idea, inasmuch as the fibres are not inorganic and amorphous in their structure like fibres of glass, but, on the contrary, they are highly organized, consisting of concentric layers of silex and keratode combined, and thus are totally different in their origin and structure from an artificial amorphous structure like glass. The term vitreous naturally supposes an origin and a transparency through the agency of fire; but if we submit the fibres of *Dactylocalyx pumiceus* to the action of that element by making a small portion of the rigid skeleton red-hot two or three times in the flame of a spirit-lamp, it comes forth from the trial as black as charcoal, and perfectly opaque.

If the term vitreous is meant to represent the general character and appearance of these sponges in their natural condition, it is then still more inappropriate, as in the living state their external appearance is that of an ordinary sponge entirely enveloped in a more or less fleshy dermal envelope; if at all applicable, it can only be so when the animal is in a deteriorated and partially decomposed condition; while siliceo-fibrous is correctly expressive of the nature of their structure, and contrasts well with the terms kerato-fibrous and spiculo-fibrous. For these reasons, therefore, I feel under the necessity of rejecting the new designation proposed by the learned Professor.

Prof. Wyville Thomson, in his proposed arrangement of the *Spongiadæ* "Order I. (P. silicea) Vitrea," gives the following as the characters of his proposed new order:—"Sarcode in small quantity, very soft; never containing formed horny matter, either fibrous, membranous, or granular. The skeleton consists entirely of siliceous spicules, either separate (in fascicles or scattered) or anastomosing, and combined into a siliceous network. The sarcode contains small spicula of a different character from the general spicules of the skeletons, and of complicated forms. The spicules, whether of the skeleton, or of the sarcode, may all be referred to the hexradiate stellate type. Ex. *Hyalonema*, *Dactylocalyx*."

Dr. Wyville Thomson's endeavour, by the institution of his proposed new order Vitrea, and his description of its characters, has, instead of elucidating the subject, still further complicated it. All the members of his new order should certainly agree in a series of definite structural characters; but this is not the case. Thus he gives, as examples of his order, *Hyalonema* and *Dactylocalyx*, the sponge of the first having a skeleton composed of spicula cemented together by keratode, as in the great mass of Halichondroid sponges, the mass of the skeleton being eminently elastic and entirely destitute of siliceo-fibrous structure, while in the latter genus the skeleton is perfectly rigid, being composed entirely of inelastic siliceo-fibrous tissue.

But this is not the only error in the descriptions of the characters of his proposed new order Vitrea; thus he states (Ann. & Mag. Nat. Hist. p. 120) of the sarcode:—"It is small in quantity, very soft, probably semifluid, extending in a thin layer over the fascicles of siliceous needles and over the siliceous framework."

Dr. Thomson's description of the sarcode in this tribe of sponges is correctly applicable as regards quantity, if, as appears to have been the case, he has derived his conclusions from an examination of the prepared skeletons of the sponges in the Museum of the Jardin des Plantes and the British Museum; but it is a mistake to imagine that the sarcode is deficient in quantity when in their natural condition. In *Dactylocalyx heteroformis*, *D. M^cAndrewia*, *D. Prattii*, and *D. Masoni* which are in the same condition as when taken alive from the sea, there is quite as much of that vital substance in their interstitial cavities as we find in the greater portion of siliceo-reticular sponges, and frequently more in proportion than we find in many of them. It is also an error to conclude that there are no membranous tissues within them. The usual delicate interstitial membranes exist in their cavities to about the same extent as in other sponges.

The author also says, in his character of Vitrea, "never containing formed horny matter, either fibrous, membranous, or granular." Now *Hyalonema* contains an abundance of horny matter, cementing the spicula together in the basal mass of the sponge, and also in the coriaceous envelope of the so-called "glass rope" of the sponge, and *Dactylocalyx* has plenty of membranes in the interstices of the skeleton, and an extensive and elastic dermal membrane enveloping the whole of the sponge.

Prof. Thomson's description of the characters of his proposed new order embraces very many more genera than he could possibly have contemplated when he wrote it. He says, "The skeleton consists entirely of siliceous spicules, either separate (in fascicles or scattered) or anastomosing and combined into a siliceous network." Let us now see what the effect of this very sweeping character will be:—1st, under the head of spicules "separate," it will include the genera *Hymeniacidon* and *Hymeraphia*; 2nd, "spicula in fascicles," it will embrace ten other genera, viz. *Geodia*, *Pachymatisma*, *Ecionemia*, *Dictyocylindrus*, *Polymastia*, *Ciocalypta*, *Tethea*, *Phakellia*, *Microciona*, and *Hymedesmia*; 3rd, "combined into a siliceous net-

work," it will include six other genera, *Halichondria*, *Hyalonema*, *Isodictya*, *Spongilla*, *Diplodemia*, and *Desmacidon*. We have thus no less than eighteen genera, not one of which has a particle of true siliceo-fibrous structure in their skeletons, incorporated with *Dactylocalyx* and the other truly siliceo-fibrous species. Such a character, instead of facilitating the discrimination of species, is calculated to lead us unto a perfect maze of doubt and uncertainty; and all this while he entirely ignores the existence of solid siliceous fibre.

The author's application of negative characters in his description of his order Vitrea is certainly bad: it is positive characters that lead us to correct discrimination of orders, genera, and species; it is what they are that must be our guides, not what they are not. If Prof. Wyville Thomson had a more extensive and intimate knowledge of the species of siliceo-fibrous sponges than he appears to possess, I can readily imagine that he would not have fallen into the errors that I have pointed out.

Dr. Thomson, in his highly imaginative paper "On the Vitreous Sponges," has not only proposed a new and very impracticable order for their reception, but he has also, contrary to all the established canons of nomenclature, proposed to abrogate the established generic names of the working naturalists who have preceded him in writing on the siliceo-fibrous sponges; and, after criticising their differences of opinion very freely, he at once proposes that they shall all be abolished, and his newly concocted name *Habrodictyon* be established in their stead. If the new name were illustrative of new ideas, or of new facts, it might be entitled to consideration; but as we find neither the one nor the other in the learned professor's paper, I do not think he can reasonably expect that it will be adopted.

Before we commence the descriptions of the genera and species of the siliceo-fibrous sponges, it will be as well to ask, what is a siliceo-fibrous sponge? and in what important points of structure does it differ from the general mass of the Spongiadæ? In the extensive order Silicea we find by far the greater number of genera are characterized by the existence of siliceous spicula in their skeletons, and that they are separated from each other by peculiar modes of their arrangement in the structures. In all the genera comprised in the siliceo-reticulate and spiculo-fibrous sponges nature has provided in their structure for their capability of expanding and contracting their skeletons to a certain limited extent; and this power appears to be inherent in all parts of the animal mass. We therefore find the dermal integuments closely adherent to the surface of the animal, expanding and contracting in unison with the general mass. This is not the case with a siliceo-fibrous sponge. The whole mass of the skeleton is formed of a continuous reticulation of solid siliceous fibre, which renders the skeleton perfectly inexpansible; but to compensate for this apparent defect in its economy, these sponges are provided with a peculiar expansile dermal system, the dermal membrane being furnished abundantly with connecting spicula, the distal surfaces of which are closely cemented to the inner surface of

the membrane, while their shafts are freely suspended in the interval existing between the dermal membrane and the surface of the rigid skeleton; so that when the animal is actively inhaling or exhaling, the expansile dermal system expands or contracts in accordance with necessities of its vital actions; but when in a state of inaction or repose, it subsides on to the rigid surface of the skeleton, and the long shafts of its connecting spicula are immersed in its interstices. This singular and beautiful provision of nature prevails in all the known siliceo-fibrous sponges which are in the condition they were when alive in their native element; it also readily accounts for the naked skeleton-like structure of many of the specimens of *Dactylocalyx* and *Iphiteon* which are preserved in the museums of London and Paris. The whole of this beautiful dermal structure is held together in life by the tough and elastic dermal membrane; but as soon as this is removed, either by decomposition or maceration in water, the remainder is the skeleton only of the animal, with probably a few of the retentive and interstitial spicula entangled in the interstices of the skeleton. I have not seen one of these sponges taken from the sea; but in two specimens in my possession, which were dried in the living condition, *Dactylocalyx Prattii* and *Masoni*, their external appearance is that of being enveloped in a thin brown leathery or parchment-like skin, and not the slightest indication of the beautiful rigid siliceo-fibrous skeleton is visible. In *D. Prattii* the expansile dermal membrane in its present condition is contracted into folds and ridges at the margin of the sponge, strongly indicating its lax and expansile nature when in the living state. I immersed one end of my specimen of *D. Masoni* in water for about half an hour; on removing it from the water, the dermal surface presented a smooth and slightly glazed appearance, and the membrane was readily removeable by the point of a penknife from the mass of the skeleton. When thus removed, I submitted it, immersed in water, to a power of 108 linear; I found that the sarcode lining it was so abundant and so much expanded by the water it had imbibed, that I could not see the apices of the numerous connecting spicula imbedded in it, their long shafts only being visible on its inner surface projecting through the stratum of sarcode. A thin slice of the rigid skeleton prepared under the same circumstances presented similar difficulties; the siliceous fibres were completely obscured by the abundance of the sarcode present, which filled all the interstitial cavities, appearing like a firm gelatinous matter of a deep-brown colour; and it was not until the specimens under consideration were dried, the sarcode again contracted into comparatively a thin film, and the specimens mounted in Canada balsam, that any of the siliceous structures of the sponge could be rendered distinctly visible. This abundance of the sarcode and its capability when in the dried state of imbibing water with great avidity are not peculiar to the siliceo-fibrous sponges; a great number of the Halichondroid sponges, under similar circumstances, present precisely the same phenomena.

If we make sections in the dried state of either of the sponges

of which I have been treating at right angles to their surfaces and then mount them in Canada balsam without previously immersing them in water, we frequently find portions of their surfaces in which the expansile dermal membrane has dried without having come into close contact with the rigid skeleton beneath it, and we see the shafts of the connecting spicula pendent from the inner surface of the dermal membrane and freely suspended in the intervening space; and under these circumstances we also frequently see a secondary thin brown dermal membrane closely adhering to the surface of the rigid skeleton. Fig. 6, Plate V., represents such a section from *Dactylocalyx Prattii*.

When the expansile dermal system in *Dactylocalyx Prattii* has been removed, we find the surface of the rigid skeleton closely covered by this continuous enveloping membrane, which in its present condition is closely adherent to the external surface of the rigid skeleton: while this membrane is in its natural state and position, no orifices whatever are observable in it; but when it is removed, we find immediately beneath it, on the surface of the rigid skeleton, a vast number of incurrent orifices of about the average diameter of one-third of a line. They are very evenly dispersed at about three or four times their own diameter from each other. That the enveloping membrane above them should appear imperforate is perfectly natural while the sponge is in a quiescent state; and there is no doubt that when requiring nutriment, imbibing-pores would be opened above each of the incurrent canals of the skeleton, in the same manner as in *Geodia* and numerous other similarly constructed sponges.

From the lengths of the shafts of the connecting spicula, which vary in some species from $\frac{1}{100}$ to $\frac{1}{200}$ inch, we may estimate tolerably closely the range of the contractile and expansile capabilities of the dermal system; and it is exceedingly probable that this space contains the aërating organs of the animal, and is truly the homologue of the large intermarginal cavities that are so numerous in the dermal crust of *Geodia Barrettii* and other closely allied sponges (see Phil. Trans. for 1862, pl. 32. fig. 2, *a a*, p. 788; and 'Monograph of British Spongiadæ,' vol. i. pl. 28. fig. 354, *a a*, p. 171). And this idea is rendered more probable by the existence of the innumerable spherical vesicles on the corresponding membrane of *Iphiteon Ingalli*, which have every appearance of being the basal cells bearing the vibratory cilia during the life of the animal.

The most decisive and valuable specific characters are those derived from the connecting spicula. They vary to a very considerable extent in different species in both size and form; but whatever may be the shape of their apical radii, their mutual connexion is always so ordered that not only is there abundant means for their combined mass to expand at right angles to the surface of the rigid skeleton, but there is always ample room for a great amount of expansion and contraction in a lateral direction; and however complicated or eccentric may be the radii of their apices when seen separately, when *in situ* they always form a compact reticula-

tion, each ray being so adapted to the structure of its neighbour as to render its eccentricity of form, when separate, no longer apparent when in combination (Plate V. fig. 8). The apices of the connecting spicula are exceedingly various in their forms, but they are all modifications of the triradiate one, even in the peltate forms; the triradiate canals passing from the distal termination of the central canal of the shaft at once indicate the connexion with the normal structure, as represented Plate V. figs. 9, 10, 11.

The general mass of the fibro-siliceous skeleton in the genera *Dactylocalyx* and *Iphiteon* varies considerably in the different species. In some it is quite smooth, in others tuberculated or spinous; but it is constant in its characters in each separate species; and besides its generic value, it very frequently affords valuable specific characters. Amidst the tissues of these sponges we find a secondary series of skeleton-fibres which are auxiliary to the primary ones, from which they differ in form and character to a very considerable extent. In the young condition they assume very much the aspect of the rectangulated hexradiate spicula; but they differ from the latter in always being based upon the skeleton-structure. In their progressive development they also unite readily with other fibres of a like description with which they may come in contact, a habit never assumed by true spicula of a similar form; and if in the course of their projection they do not meet with other similar fibres, they occasionally produce a second crop of rectangulating radii, a habit which has never yet been observed to occur in rectangulated hexradiate spicula; and although the latter are frequently intermixed with the auxiliary fibres, the spicula and the fibres are always distinctly separate from each other.

The especial office of the auxiliary fibres is evidently that of affording support to the interstitial membranes: they are rarely found in the compact portions of the rigid skeleton; but wherever there has been a large vacant space in those structures, there we find them projected into the space, anastomosing freely with each other, supporting thin films of interstitial membrane, and ultimately filling up spaces in the skeleton with solid fibrous structure, as represented in the large interstitial spaces (Plate III. fig. 1, *a*, *a*, *a*). Auxiliary fibres are frequently found in the interstitial spaces of keratose sponges; but in this class they always assume the character of the common skeleton-structure of the sponge in which they occur, the only difference being that they are very much more slender than the surrounding skeleton-structures.

The simple rectangulated hexradiate spicula occur, either singly or in fasciculi, in some species of siliceo-fibrous sponges in considerable numbers; in others they are of rare occurrence, or entirely absent. Their office is evidently purely that of affording support and extension to the interstitial membranes. They never anastomose with each other, or unite with any portion of the rigid skeleton. They are generally very slender, and when loosely fasciculated they accord in position. Their radii are frequently incipiently spinous at their apices, apparently for the purpose of affording a secure attachment

to the membranes they are destined to support, and which, in well-preserved specimens, may be seen stretching from point to point of the radii. Fig. 2, Plate III., represents a spiculum of this form × 108 linear.

In some species of siliceo-fibrous sponges there is a paucity or a total absence of the rectangulated auxiliary fibres and of the simple rectangulated hexradiate spicula; in such cases we frequently find their places supplied by numerous long acerate interstitial spicula dispersed in the interstitial spaces of the rigid skeleton, their office appearing to be to increase the surfaces of the nutrimental membranes. In specimens in which the animal matter is well preserved, the membranes are seen stretching from point to point of each spiculum, and from the points of one of these spicula to those of other similar ones in its neighbourhood; and as these spicula occur grouped together frequently in considerable numbers, it may be readily conceived that they perform an important office in thus increasing the amount of the nutrimental surfaces within the animal. The incipient spination of the radii, so prevalent in this form of spiculum, admirably fits them to maintain their hold of the delicate interstitial membranes which are attached to them.

The spinulo-trifurcated hexradiate stellate (Plate III. fig. 4) and other forms of those spicula appear to be peculiar to the siliceo-fibrous sponges. In the well-washed specimens they do not seem to be very numerous; but in cases where the interstitial membranes are in a good state of preservation, they are occasionally found to be so abundant and so closely packed together as to completely cover and obscure the membrane beneath them. Occasionally the hexradiate stellate forms occur with the radii attenuated and acutely terminated (Plate III. fig. 5).

This form of spiculum is abundant in the type specimen of *Dactylocalyx pumiceus*, and is probably either an abortive or an immature development of the spinulate form of spiculum. In my examination of the corresponding forms of spicula in *Iphiteon Ingalli* I found two of this attenuating form of spiculum which, under a power of 108 linear, appeared to have their radii acutely terminated; but on the application of a power of 666 linear I found that their apices exhibited incipient spinulation; and these spicula were the only two that I could find, although I searched for other specimens in a similar condition amidst a crowd of spinulate ones which completely covered a fragment of membrane that I obtained from the sponge while in the possession of my late friend Mr. Ingall.

The situation and peculiarities of the oscula and pores afford important characters in the determination of the species in all sponges. In the cup-shaped siliceo-fibrous sponges the oscula are situated on the surface of the inside of the cup, and the pores on the outer surface. The same law obtains in the cup-shaped kerato-fibrous sponges of commerce and in numerous cup-shaped Halichondraceous species. In coating or amorphously massive sponges the oscula and pores occupy the same surface, and the incurrent and excurrent systems of canals are intermingled. The circulation of the nutrient

and effete fluids of the animal are on the same principle as artery and vein in the higher animals, the excurrent canals having their minute origins near the terminations of the incurrent canals. But this distribution of the two systems does not obtain in all massive sponges. In some species of symmetrically oval or nearly spherical forms we find a modification of the system that obtains in the cup-shaped sponges, the inner portion of the cup being replaced by a large central cloacal tube into which the effete streams from the sponge are poured, and from the mouth of which they are projected, in many cases with a considerable degree of force.

This system is well exemplified in the genus *Grantia*.

Among the siliceo-fibrous sponges, we recognize the same principle in *Iphiteon beatrix* (*Aphrocallistes beatrix*, Gray), which in every other peculiarity of its skeleton is truly an *Iphiteon*. This variation in its habit from the cup-shaped siliceo-fibrous sponges is not sufficient to constitute it a separate genus, as we frequently find in the same species of sponges (as in *Halichondria panicea*) that one individual is massive with simple surface-oscula, while larger specimens, in addition to the surface-oscula, have several large cloacal appendages, receiving the excurrent streams in their cavities and discharging them from a common orifice. Such modifications of the excurrent system prevail to a very considerable extent in many other sponges; but the type of the skeleton-structure, which should always form the basis of generic characters, is never found to vary under any circumstances.

The descrimination of the genera and species of the siliceo-fibrous sponges is by no means a difficult task if we address ourselves to the operation with a sufficient degree of care and attention.

In our determination of genera it is necessary that the skeleton-structures should be examined in sections parallel to the surface of sponge, as well as in those at right angles to it, as the general aspects of these two sections are essentially different. Thus in *Iphiteon callocyathes* a section of the skeleton at right angles to the confluent radial strata presents no appearance of the rotulate arrangements of the fibre that are so characteristic of the genus; and in *Myliusia* the crypt-like form of the skeleton is only distinctly visible in a section at right angles to its surface.

The most efficient and striking specific characters are to be found in the expansile dermal system, in the spicula of the dermal membrane, and in the peculiarities of the structure of the connecting spicula. The characters derivable from the skeleton-fibre are often very effective; but in several of the species they so closely resemble each other as to be relatively of very little value as distinctive characters, while in no two of the known species of siliceo-fibrous sponge have we ever seen the same forms of connecting spicula and spicula of the dermal membrane occurring together. In the discrimination of species we should especially note the peculiarities of this interesting and beautiful dermal organism; and a portion of it should be boiled in nitric acid to obtain the spicula contained in it in a separate state.

When the expansile dermal system is present wholly or in part in specimens under examination, we are enabled to establish specific characters of external form and structural peculiarities of the most satisfactory description; but when that important portion of the organic structure of the sponge is absent, the characters derived from the form and surface of the rigid skeleton are necessarily provisional, and can maintain their places in its description only until a specimen in a natural and perfect state can be procured. When in the denuded state, the form and surface of the sponge should be stated as those of the rigid skeleton, not as that of the sponge.

Genera.

DACTYLOCALYX, Stutchbury.

Skeleton siliceo-fibrous. Fibres solid, cylindrical. Reticulations unsymmetrical.

Type *Dactylocalyx pumiceus*, Stutchbury, P. Z. S. 1841, p. 86.

IPHITEON, Valenciennes.

Skeleton siliceo-fibrous. Fibres solid, cylindrical. Reticulations symmetrical. Areas rotulate, confluent.

Type *Iphiteon panicea*, Museum Jardin des Plantes, Paris, from Porto Rico, 1799.

MYLIUSIA, Gray.

Skeleton siliceo-fibrous. Fibres solid, cylindrical. Rete symmetrical, disposed in a series of crypt-like layers parallel with the external surface, with intervening planes of perforated siliceous tissue.

Type *Mylinsia callocyathes*, Gray, from the Island of St. Vincent, P. Z. S. 1859, p. 439, and 1867, p. 506.

KALIAPSIS, Bowerbank.

Skeleton siliceo-fibrous. Basal fibres cylindrical and canaliculated; distal fibres non-canaliculated, compressed. Basal reticulations symmetrical and reversedly arcuate; distal reticulations unsymmetrical and continuously ramifying.

Type *Kaliapsis cidaris*, Bowerbank.

FARREA, Bowerbank.

Skeleton siliceo-fibrous. Fibres canaliculated, canals continuous. Rete symmetrical; interstices rectangulated.

Type *Farrea occa*, Bowerbank.

PURISIPHONIA, Bowerbank.

Skeleton siliceo-fibrous. Fibres canaliculated, canals continuous. Rete unsymmetrical.

Type *Purisiphonia Clarkei*, Bowerbank.

ALCYONCELLUM, Quoy et Gaimard.

Sponge fistulate; fistula single, without a massive base. Skeleton siliceo-fibrous; primary lines radiating from the base in parallel straight or slightly spiral lines; secondary lines at right angles to the primary ones. Oscula congregated, with or without a marginal boundary to their area.

Type *Alcyoncellum speciosum*, Museum Jardin des Plantes, Paris.

DACTYLOCALYX PUMICEUS, Stutchbury.

Sponge cyathiform, slightly pedicelled. Surface even. Oscula and pores unknown. Expansile dermal system—connecting spicula furcated, attenuato-patento-ternate, and dichotomo-patento-ternate. Dermal membrane—tension-spicula small acerate and subequiangular triradiate spicula; retentive and defensive spicula acerate or cylindrical verticillately spinous, whorls of spines numerous and very large; and also attenuato-stellate, very minute, and numerous. Skeleton:—rete irregular; fibre stout, irregularly and abundantly tuberculated, apices of the tubercles minutely papillous. Auxiliary skeleton-fibres more or less rectangular hexradiate, profusely spinous, distal terminations clavate, large and numerous. Tension-spicula rectangular hexradiate, smooth, long and slender, radii subclavate. Retentive spicula trifurcated attenuato-hexradiate stellate; and spinulo-trifurcated hexradiate stellate, minute and very numerous. Gemmules membranous, aspiculous.

Colour unknown in the living state.

Hab. Barbadoes (*Dr. Cutting*), "Martinique par M. Plée, 1829."

Examined in the state of skeleton.

Stutchbury's paper descriptive of this sponge was read at the Zoological Society, Oct. 26, 1841, and was published in vol. ix. p. 86 of their Proceedings. A full account of the paper is also published in the 'Annals and Magazine of Natural History,' vol. ix. p. 504. The author describes the sponge as being "formed entirely of silex, the reticulate structure of the mass being composed of transparent vitreous tubuli without any admixture of keratose or calcareous matter." This is a mistake, as the adult fibres are solid in every portion of them from the type specimen that I have submitted to microscopical examination.

Stutchbury has characterized the species as follows:—

"Sponge fixed, rigid, siliceous; incurrent canals uniform in size; excurrent canals large, forming deep sinuosities on the outer surface, radiating from the root to the outer circumference."

In this description the author has reversed the positions of the inhalant and exhalant organs, the former being placed on the outer surface and the latter on the inner one.

The whole of these characters appertain only to its outward appearance; and the description would serve equally well for several other species beside the one to which he has applied it. I have therefore thought it necessary to characterize the sponge from its internal

structure as well as from its external aspect, in the preceding manner. The type specimen was a widely expanded cup $16\frac{1}{2}$ inches in diameter. It was divided into about equal parts; one half remains in the Bristol Museum, and the other is in the British Museum; the sides rather exceeded an inch in thickness.

The expansile dermal system, which usually contains the most strikingly characteristic parts of such sponges, is entirely absent from the general mass of the animal. The nature of the dermal membrane, the pores, and the oscula are therefore unknown to us; but without the aid of these organs there still remain sufficient permanent specific characters to enable us to readily separate this species from its nearly allied congeners, in their present denuded state. Of the two species in the British Museum, *Dactylocalyx pumiceus* and *Iphiteon Ingalli*, the latter has been figured by Dr. Gray in the 'Proceedings' of this Society for 1867 (plate 27. fig. 2), and has been erroneously designated *Dactylocalyx pumicea*; and this error is the more remarkable as the surface-characters of the two specimens differ very materially from each other. The outer surface of *D. pumiceus* is furnished with deep channel-like depressions, disposed in irregular lines radiating from the basal portion towards the margin of the sponge. These channels or large interstitial spaces penetrate deeply into its substance, so as to convey within it the newly imbibed streams from the inhalant pores. On the upper surface of the sponge these channels do not exist; but *in lieu* of them there are numerous large round or oval orifices, varying in diameter from about two lines to nearly half an inch. There is a slight tendency to an arrangement in lines radiating from the centre to the circumference. There can be little doubt of these orifices being the terminations of the great excurrent system of the sponge, and that above each of them in the living state there would be the true oscula of the dermal system of the sponge. *I. Ingalli* differs materially in its surface-characters from *D. pumiceus*. The inner surface of the cup is furnished with numerous deep channels or depressions with sharp margins, while in *D. pumiceus* the corresponding part of the sponge is occupied with numerous circular or oval orifices with rounded margins; the outer surface of *I. Ingalli* is furnished with deep more or less sinuous channels with rounded margins, while the similar channels in *D. pumiceus* are decidedly arranged in nearly straight lines. Beside these differences in external appearance, the characters of their respective skeletons at once separate them not only as species, but as genera. The irregular structure of *D. pumiceus* is readily to be distinguished from the characteristic symmetrical configuration of the circular confluent areas of *Iphiteon*.

There is also in the British Museum a piece of *D. pumiceus*, about 2 inches long by $1\frac{1}{2}$ inch broad and about $\frac{1}{4}$ inch thick, on a tablet, said to be from Barbadoes; this is probably a fragment off the large specimen from the Bristol collection, as its microscopical characters agree precisely with those of the large portions which I have examined.

There is also a small specimen of the species in the Belfast Mu-

seum in about the same degree of preservation as the type one; but in consequence, probably, of not having been so much washed to make it look pretty, it abounds in the beautiful and characteristic spinulo-trifurcate hexradiate stellate retentive spicula.

The fibre in the skeleton is abundantly but irregularly tuberculated, as represented in fig. 1, Plate III., from a section of the type specimen from Barbadoes in the British Museum, × 108 linear.

The tuberculation of the fibre is remarkable and very characteristic; when viewed with a power of about 700 linear, their apices are always more or less papillous; in some the papillæ are numerous and well produced, while in others they are in an incipient condition. Fig. 13, Plate III., represents two of the tubercles on the side of a portion of skeleton-fibre with their terminal papillæ, × 666 linear.

Beside the large primary fibres, there is a secondary series of skeleton-fibres, which are evidently auxiliary to the larger system. They occur especially in the large interstitial spaces of the sponge, their office being apparently that of filling up those vacant spaces when no longer necessary in the economy of the animal, and to sustain therein the multiplied folds of the interstitial membrane; their office in this respect is the same as that of the large rectangulated hexradiate spicula (Pl. III. fig. 2) which occur so frequently in the interspaces of the skeletons of the siliceo-fibrous sponges, and their mode of development very closely resembles that of those spicula. In an early stage of their growth they very closely simulate the form of the spicula; but instead of being freely developed amidst the membranous tissues, they are always based on the primary skeleton-fibres. A single small fibre pullulates from some part of one of the larger skeleton-ones, and is projected in a straight line into the vacant space: if it meets with none other in its progress, at some distance from its origin four lateral branches are thrown out at right angles to the axial fibre and to each other, and the axial fibre continues its progress in a straight line. If it meets no other fibre in its progress, the distal ends of the axial fibre and of the lateral ones become clavated, and all parts of the shaft and radii profusely spinous, and the whole constitutes a perfect simulation, in form, of a rectangulated hexradiate spiculum. But, on the contrary, should the axial or the radial branches meet with other such fibres, they immediately inosculate, and the previously straight radii are contorted in various directions to meet the necessities of the situation; and, as is frequently the case, where many of these fibres are projected from different bases into the same space, they unite and form one mass of small contorted fibres, while there is good reason, from the gradual increase in size of the basal portions of some of them, to believe that they are ultimately developed into the size and form of the primary skeleton-ones.

The primary skeleton-fibre averages $\frac{1}{588}$ inch in diameter; the auxiliary fibres vary from $\frac{1}{3000}$ to $\frac{1}{8000}$ inch in diameter. However closely they may simulate the form of true hexradiate spicula, they may always be distinguished from them by their attach-

ment to the primary skeleton-fibres and by their habit of inosculation.

Beside the auxiliary fibres, there are in some parts of the sponge an abundance of true rectangular hexradiate spicula (Plate III. fig. 2); but they are rarely found mixed with the auxiliary fibres or in the same spaces with them. Although occurring in closely packed groups, they never unite with each other, nor are they even attached to any parts of the surrounding skeleton-fibre, and they always preserve their normal form. They are slender, smooth, and their radii are very slightly inclined to become clavate. The termination of the elongated basal portion of the spiculum is frequently incipiently spinous. Their length is $\frac{1}{34}$ inch, the expansion of the lateral radii $\frac{1}{100}$ inch, and the diameter of the axial shaft varies from $\frac{1}{8000}$ to $\frac{1}{10000}$ inch.

The trifurcated attenuato-hexradiate stellate (Plate III. fig. 5) and the trifurcated spinulo-hexradiate stellate spicula (Plate III. fig. 4) are both very abundant, and in some small masses of sarcode they are so numerous and so closely packed together as to render it quite impossible to count them. The sarcode appears to have been very abundant, as in some parts it completely fills up the reticulations of the skeleton; it is of a full amber-yellow colour.

Thus far we have positive characters by which to discriminate this beautiful species of sponge from its nearly allied congeners; but I have been fortunate in finding other characters, which, from the mode in which they have been obtained, although not so decisive in their nature, are yet of such importance that their description cannot be omitted in treating of this species.

I carefully examined the half of the type specimen of *D. pumiceus* that is in the British Museum in the hope of finding a small fragment of the dermal portion of the sponge, but I did not succeed in detecting any remains of it on the cup-shaped portion of the specimen; but on the basal surface of the pedicel there were remains of what appears to have been the basal membrane. It consists of a dense yellow incrustation, closely intermingled with the basal skeleton-structure, and agreeing in colour and appearance with a few very minute specks of the animal matter of the external surface of the sponge. I mounted a small portion of this basal matter in Canada balsam; but this material did not render the fragments transparent; yet there were at some portions of their margins unmistakable evidences of their containing spicula. There were also fragments of the skeleton-structure of the base of the sponge, the reticulations of which were, as might be expected from their situation, very close and dense (Plate III. figs. 14 and 15); and along with these fragments there was a group of three large and very remarkable verticillately spined cylindrical spicula, very closely resembling in their structure the one represented by fig. 69, plate 3, vol. i., 'Monograph of British Sponges,' and also by fig. 23, plate 36, Phil. Trans. for 1862, but differing from those figures in being much longer in their proportions, and in having a greater number of circles of spines (Plate III. fig. 6). Having seen thus much of the dermal

structures, I treated the remaining portion of the specimen by boiling it in nitric acid, and obtained not only numerous specimens of the spicula I have described above, but others of an exceedingly interesting description, which I shall now proceed to describe.

The large verticillately spined spicula are very numerous, and exceedingly various in their proportions. They are usually more or less curved, and vary greatly in size and in the mode of their spination: some of the larger ones are acerate; that is, each end terminates in a well-produced point; others have at one end an irregular aggregation of stout spines, while the other is acutely terminated; and in some both ends are crowded with stout spines; and the general character of the shaft is that of a cylindrical spiculum. They occur in every imaginable stage of development, from extremely delicate diameters with the whorls of spines in quite an incipient condition (Plate III. fig. 6 *a*) up to the fully developed spiculum (fig. 6 *b*). The number of whorls of spines vary from 9 to 16; one with the latter number measured $\frac{1}{38}$ inch in length, and the diameter of the shaft was $\frac{1}{888}$ inch. The spines are large, acutely conical, and there are seldom more than five or six in each whorl. These spicula must have been very numerous and closely disposed in the membrane. The two small pieces acted upon by the acid would not have exceeded the space of a quarter of a superficial square inch, while the results of their dissolution by the acid would cover more than a superficial square inch, and in a microscopic field of view $\frac{1}{13}$ inch in diameter I counted as many as twenty-one of them. Under all these circumstances there can be no reasonable doubt of these spicula being those of the defensive system of the dermal membrane of the sponge; and such spicula are usually found as abundant in the basal membrane as in other parts of the dermal system.

I found also a considerable number of small equiangular or subinequiangular triradiate spicula with smooth attenuated radii, varying in size, from point to point of the rays, from $\frac{1}{222}$ to $\frac{1}{322}$ inch (Plate III. fig. 7). Such spicula are usually comparatively few in number, and are dispersed irregularly on the surfaces of the dermal or interstitial membranes of sponges. At the margin of a fragment of the sponge from very near the basal attachment, which was mounted in Canada balsam in its natural condition, I found the small equiangular spicula and little acerate ones (Plate III. fig. 8) imbedded in the membrane amidst minute attenuato-stellate ones. In this position they may therefore be regarded as tension-spicula of the dermal membrane.

Amidst the other spicula resulting from the dissolution of the fragments from the base of the sponge by nitric acid there were several furcated attenuato-patento-ternate (Plate III. fig. 9) and dichotomo-patento-ternate (fig. 10) connecting spicula. One large one of the last-named form measured across its ternate termination $\frac{1}{50}$ inch; and all of them had large central canals in their radii. These spicula appear to vary considerably in size; a smaller one measured $\frac{1}{166}$ inch in greatest expansion. There can be no doubt that they belonged to the expansile dermal system of the sponge; and the small number of them found may be accounted for by their

forming no part of the economy of the basal membrane, although usually abounding in the dermal one; and their presence may be accounted for by the fact that the material operated on was principally taken from the margin of the base of the sponge, at the junction of the membrane of the pedicel with that of the base.

Imbedded in the remains of the membranous structures operated upon by nitric acid, there were a few very minute attenuato-stellate spicula; and I subsequently found at the margin of a fragment of the basal portion of the sponge, mounted in Canada balsam in its natural condition, several dichotomo-patento-ternate connecting spicula *in situ*, and along with them a crowd of the minute attenuato-stellate ones. They were so numerous as to entirely obscure the small portion of dermal membrane on which they reposed. The regular mode of their disposition on the membrane, and the contact of the latter with the expanded outer surface of the heads of the dichotomo-patento-ternate connecting spicula, unmistakably indicates their especial office and true position in the sponge as retentive and defensive spicula of the dermal membrane.

I measured several of these minute spicula. The largest was $\frac{1}{1287}$ inch from the opposite points of their radii; the smallest was $\frac{1}{2703}$ inch in extreme diameter; but by far the greater number were about $\frac{1}{2000}$ inch in diameter, and the largest measurement was of rare occurrence. Occasionally, but very rarely, the radii were cylindrical, instead of attenuating to an acute point.

From the indications afforded by the spicula I have described above we may reasonably predict that, when a specimen of *D. pumiceus* shall have been found in a living state and perfectly preserved, we shall find it to be furnished with a beautiful expansile dermal system similar in character to those of the siliceo-fibrous sponges which are well known to us in a perfect state of preservation, such as *D. Prattii* and *D. Masoni*. But our evidence regarding the structure of the sponge is not yet exhausted; for by a careful examination of a series of minute fragments which I subsequently obtained from the margin of the base of the type specimen in the British Museum and mounted in Canada balsam in their natural conditions, I strengthened the evidence obtained from the spicula operated on by nitric acid. In several cases these spicula were seen imbedded together in the same membrane at the transparent edges of the fragments under examination. In one such case the membrane was thickly studded with the minute attenuato-stellate spicula, and amidst them was imbedded one of the subequiangular triradiate and several of the small acerate tension-spicula; from the edges of another fragment the ternate heads of two connecting spicula, covered by dermal membrane containing innumerable minute attenuato-stellate spicula, were projected, thus confirming the inferences raised by the spicula arising from the dissolution of the fragments in nitric acid.

The evidence derived from the dissolution of portions of the basal part of the sponge in nitric acid might reasonably be questioned; but when we are able to confirm it by detecting the spicula separated

by the acid imbedded together in their natural conditions in the membranes of the animal, this at once removes all doubts respecting their really appertaining to the animal under consideration.

In a small fragment of the skeleton from the inner surface of the sponge near the base I found portions of the interstitial membranes filling the areas of the network of the skeleton in a good state of preservation; they were coated with dense yellow sarcode, in which were a considerable number of trifurcated hexradiate stellate spicula completely imbedded; but I could not detect any of the minute attennato-stellate, the equiangular triradiate, or the small acerate spicula; it may therefore be fairly inferred, from their absence in the interstitial membranes, that the latter three forms appertain more especially to the dermal one, in which they occur in such abundance.

In the Museum of the Jardin des Plantes at Paris there are two very interesting specimens of *Dactylocalyx pumiceus*; one is a small and apparently young specimen, the other a tall ewer-shaped specimen in a well-developed adult condition. The first of these two specimens, I was informed, had not been in the possession of Dr. Lacaze-Duthiers more than a few weeks previously to my seeing it. It was labelled "*Iphiteon panicea*, Valenciennes. La Martinique." It is $2\frac{3}{4}$ inches in height, and the same in diameter at the top of the cup. It is based on the edge of a flat piece of what is apparently tufa. In form, it is a symmetrical cup without a pedicel; the base is about $1\frac{1}{4}$ inch by 1 inch in diameter. The thickness of the cup at the margin varies from a quarter to rather exceeding half an inch. On the outer surface there are deep channels running most frequently in a longitudinal direction, varying in width from about 1 to 2 lines, and in length from $\frac{1}{2}$ inch to 2 inches; and where they are not present, their places are supplied by round or oval deep apertures. On the interior surface there are also 9 or 10 lines of large round or oval apertures radiating from the base of the cup to the margin. Many of these deep interstitial cavities pass entirely through the sides of the cup, so that they are common to both internal and external surfaces. In some of these cavities on the inside of the cup there were one or two long slender spicula, the whole lengths of which could not be seen.

The structural peculiarities of the skeleton agree perfectly with those of the type specimen of Stutchbury's genus *Dactylocalyx*, and the specific characters, as far as they were present, with the species *pumiceus*. The specimen has been too well washed, to make it look beautiful; but notwithstanding this injudicious treatment, I found, in the minute section of the skeleton, made at right angles to its surface, several little groups of spinulo-trifurcated hexradiate spicula imbedded in the remains of the animal matter.

The second or ewer-shaped specimen is 14 inches in height; its upper margin is not circular, but has one portion of its circumference bent outward and downward like the lip of a large water-ewer. At this depressed part it is $12\frac{3}{4}$ inches across; and at right angles to this line the measurement is 10 inches. It is labelled "*Iphiteon panicea*" from "Martinique par M. Plée 1829." It has no part

remaining of the basal membrane or true surface of attachment, and has in the centre of its present base a hole through it big enough to receive my first finger; and it is probable that the true base was an inch or more below the present one. On its external surface it has numerous wide and deep channels, radiating irregularly from the base towards the margin of the cup. The ridges between these channels have rounded edges, and they have frequently round or oval apertures irregularly dispersed upon them. Both channels and round orifices penetrate deeply into the substance of the sponge. The interior surface has very few of these interstitial channels; but there are an abundance of large cavities of a somewhat funnel-shaped form, their lower orifices being small compared with their surface ones, many of which are $\frac{1}{2}$ inch in diameter. There is a very slight tendency towards a radial arrangement of these large orifices.

The results of the microscopical examinations of fragments of the tissues of this sponge from various parts were exceedingly satisfactory. From the part of the base of the sponge, where it is stained yellow by the remains of the animal matter, I obtained portions of membranous structure containing numerous specimens of dichotomo-patento-ternate spicula, like those in the basal membrane of the type specimen in the British Museum. Dense patches of small acerate spicula with numerous minute simple attenuato-stellate ones intermixed with them, precisely similar to those in the type specimen, were also abundant and *in situ*, completely covering and concealing comparatively large fragments of the skeleton-tissues. A few fragments of a basal siliceous reticulation similar to that in the type specimen were also observed.

From a part of the external surface of the sponge near its upper margin, which was stained of a brown colour by the animal matter, I obtain fragments containing numerous patches of dark amber-coloured sarcode and a considerable number of gemmules *in situ*. They are globose and variable in size (Plate III. fig. 12); they are membranous and aspiculous, and are very like those figured in plate 25. fig. 340, 'Monograph of British Spongiadæ,' vol. i., from *Iphiteon panicea* in the Museum of the Jardin des Plantes. Imbedded in the patches of sarcode there were trifurcated attenuate and spinulo-trifurcated hexradiate stellate spicula in considerable quantities; and in some dust shaken out of the inside of the sponge numerous fine specimens of the large fusiformi-acerate spicula, like those of the type specimens, were obtained. The discovery in the French specimen of the dichotomo-patento-ternate spicula, and the patches of the small acerate and simple attenuato-stellate spicula intermingled, is highly satisfactory, as it places beyond a reasonable doubt their true positions in the sponge, and that they were not adventitious in the type specimen, but were really characteristic of the species; and at the same time it marks the specific identity of the French specimen with the type one of Stutchbury's genus.

None of the large acerate or cylindrical verticillately spinous spicula which abound in the basal membrane of the type specimen, or of the subequiangular triradiate spicula of the dermal membrane,

were observed; but their absence may be readily accounted for by the condition of the basal portion of the French specimen and the apparently total destruction of its dermal membrane. In every other specific character there is a complete agreement between the two specimens under consideration.

Among the spicula resulting from the dissolution of a portion of the basal structures of the type specimen of *D. pumiceus*, I found two trifurcated expando-ternate spicula, which are represented by fig. 14, Plate III., ×666 linear. They are very minute, and probably belong to an unknown species of the genus, and were adherent to the basal membrane of *D. pumiceus*. I have never met with this form of spiculum before; I have therefore thought it advisable to record its occurrence.

Dactylocalyx heteroformis, Bowerbank.

Coscinospongia heteroformis, Valenciennes.

Sponge sessile, fan-shaped, plicated sinuously. Surface slightly undulating, minutely hispid. Oscula on the upper surface slightly elevated and marginated, margins rounded; uniform in size and very numerous, irregularly dispersed, rarely exceeding one-third of a line in diameter. Pores congregated on the under or inhalant surface; porous areas scarcely visible to the unassisted eye, slightly depressed, very numerous, dispersed, rarely more than once their own diameter from each other. Expansile dermal system exceedingly ramified and complicated; inhalant surface furnished abundantly with long, slender, flexuous spicula, irregularly dispersed amid the dermal fibres. Dermal membrane pellucid, furnished with a fine but very irregular network of apparently siliceous fibres. Skeleton —reticulations close, irregular, and very much ramified; fibre smooth, slightly compressed; frequently terminating in dense short tufts of minutely ramified fibres.

Colour in the dried state, dark brown.
Hab. Shanghai (*M. Montigny*, 1854).
Examined in the dried condition.

The sponge is composed of numerous sinuous plications or folds from 3 to 4 lines in thickness near the margin. It is 5 inches in height, $4\frac{1}{2}$ inches in breadth, and, including the plications, from 3 to 4 inches from back to front. The membranous and sarcodous tissues are apparently in the same state of preservation as when taken from the sea in a living condition. The surface of the plications is slightly undulated. The hispidation of the surface is not visible to the unassisted eye; but, in a section at right angles to the surface, beneath the microscope it is distinctly apparent. The integral parts of the expansile dermal system appear to be inextricably locked together; but this external layer of tissue is distinctly separated from the solid mass of the skeleton beneath it. The porous system on the under or inhalant surface of the sponge is a very beautiful microscopical object. The inhalant areas are exceedingly numerous and closely adjoining each other; they vary to some extent in their

form from circular to oval, and occasionally they are nearly oblong. They are protected from the incursions of minute annelids and other enemies by the projection into their areas of the furcated terminations of the skeleton-fibres of the surface-tissues (Plate IV. fig. 2). This beautiful mode of defence is very characteristic of the species, and is an excellent substitute for the usual defensive spicula in such organs. Beside this mode of defence, the dermal surface is furnished rather abundantly with long slender flexuous spicula, which pass over the inhalant areas in various directions.

The oscular surface of the sponge is not furnished with the same minute slender acerate spicula that abound on the inhalant one, but the whole of the former surface is protected by a modification of the style of defence that is so beautifully exhibited on the margins of the inhalant areas. The oscular membrane which closes that organ and the slightly elevated ring whence it proceeds have not the same furcated defences that are so abundant at the margins of the inhalant areas; but as we focus downward through the orifice towards the surface of the rigid skeleton of the sponge, we occasionally observe some of the furcated defences projecting from the parietes of the cavities. The oscular membranes at several of these orifices were in a semicontracted state; numerous minute grains of sand were scattered on their external surfaces, but no spicula were apparent in any of the membranes. In one of them the margin was in a very perfect condition, slightly thickened; and the membrane exhibited faint concentric lines of contraction (Plate IV. fig. 3).

The dermal membrane is pellucid, and is furnished with a fine but very irregular network or stratum of slender siliceous fibres, their siliceous structure being well characterized by the frequency of their fractures at right angles to their axes; they do not appear to anastomose, but to overlie each other without any approach to symmetry in the mode of their disposition. Plate IV. fig. 4 represents a small portion of this tissue beneath a power of 308 linear.

The skeleton-tissue is exceedingly irregular and intricate. The fibres of which it is composed are more or less compressed; they are quite smooth, but frequently throw off short branches which terminate with crowded masses of minute ramifications of siliceous structure.

In July 1861, when I first saw this sponge in the collection of the Jardin des Plantes at Paris, the late Professor Valenciennes told me that he had not yet described it; and on the occasion of my last visit to Paris, in May 1868, I could not learn that he had subsequently done so. I am therefore quite ignorant of the characters he would have assigned to his genus *Coscinospongia*; but as it agrees in the structure of its skeleton with Stutchbury's previously established *Dactylocalyx*, I have assigned it to that genus accordingly.

DACTYLOCALYX M^cANDREWII, Bowerbank.

MacAndrewia azorica, Gray, P. Z. S. 1859, p. 438, plate xv.

Sponge pedicelled, sinuously cup-shaped. Surface even or slightly undulating. Oscula small, evenly dispersed on the inner or

exhalant surface; simple or slightly elevated and marginated. Pores inconspicuous, evenly dispersed on the outer or inhalant surface, furnished with a protective fringe of minute short acerate spicula. Expansile dermal system—dermal membrane abundantly furnished with minute, short, stout, acerate spicula, evenly matted together. Connecting spicula foliato-expando-ternate; foliations of the apex depressed, very elaborate and irregular, shaft rather long. Skeleton-surface covered by a secondary dermal membrane; abundantly furnished with minute, short, acerate spicula, same as those of the primary dermal membrane. Skeleton-fibres somewhat compressed, smooth, furnished at intervals with groups of large spicular attenuated spines. Sarcode in the dried state amber-coloured.

Colour, in the dried state, nut-brown.
Hab. St. Michael's, Azores (*Robert M^c^Andrew, Esq.*).
Examined in the dried state.

This sponge was described by Dr. J. E. Gray in the 'Proceedings' of this Society for 1859, p. 438, plate xv. *Radiata*, under the name of *MacAndrewia azorica*. In its external appearance it very closely resembles *Dactylocalyx heteroformis* of the Museum of the Jardin des Plantes, Paris, and *Dactylocalyx Prattii*; but in its structural characters it differs in many important respects from either of them.

The structure of the skeleton is truly that of a *Dactylocalyx*, and I have therefore referred it to that genus.

The description of the genus in the 'Proceedings' of this Society for 1859 refers only to its external characters, and is so vague that it might be equally well applied to several other species of this tribe of sponges. In the 'Proceedings' for May 1867 Dr. Gray gives another version of its generic characters, in which he designates the sponge as a coral, thus:—"The coral expanded, cyathiform; the upper and lower surface smooth, the upper surface with small oscules; the fibres of skeleton small, with stellate spicules on the dermal surface. The stellate spicules three-rayed; the rays forked and reforked. Bowerbank, British Sponges, fig. 53." This description is not only quite as vague as the original one, but, in addition, is very incorrect. In the first place, the specimen is undoubtedly not a coral; and, secondly, there are no stellate spicula on the dermal surface, nor have the connecting spicula "the rays forked and reforked." And the reference made to 'British Sponges,' fig. 53, is a mistake, as a reference to that work will prove, the spiculum there represented by the figure quoted being "a spiculated dichotomo-patento-ternate" one "from an unknown sponge." And, moreover, no such form of spiculum is to be found in Dr. Gray's *MacAndrewia azorica*. The specimen is in the British Museum.

The sponge is elevated on a short stout pedicel, from the top of which it expands into an irregular sinuously shaped cup with rounded margin. The external or inhalant surface is smooth, but slightly undulating. The internal or exhalant surface is slightly roughened by the presence of the oscula, which are evenly distributed over the

whole of its surface; they rarely exceed a line in diameter; the smaller ones are frequently simple orifices, the larger ones are slightly elevated and marginated. The pores are not visible without the aid of considerable microscopical power; with about 100 linear their structure exhibits an exceedingly beautiful appearance. They each occupy an area formed by the intermingling of the elegant foliations of the ternate connecting spicula; and each little porous area is furnished with a regular fringe composed of a single series of the small dermal tension-spicula, which, projected from its margin inwards, meet at about the centre of the space, forming a complete defence against the incursions of any minute enemy; in the dermal membrane around, the minute tension-spicula are closely and irregularly matted together (Plate IV. fig. 5).

When we view a section of the sponge made at right angles to its surface, the structural peculiarities of the expansile dermal system of this tribe of sponges are very beautifully displayed. The outer surface is densely covered with the terminations of the ternate spicula of that organ, and again with the dermal membrane and its closely matted tension-spicula. Immediately beneath we see the pendent shafts of the ternate spicula, more or less clothed with minute acerate spicula, and with the proximal terminations of the shafts cemented by keratode to projecting portions of the fibre of the rigid skeleton, the surface of which is covered by a stratum of membranous structure, abundantly furnished with minute acerate spicula; the space between this surface-membrane of the rigid skeleton and the under surface of the expansile dermal system forms a large cavernous or crypt-like cavity supported by innumerable pillars at about equal distances from each other.

The arrangement of the fibres of the rigid skeleton have all the complete irregularity of a *Dactylocalyx*, and there is not the slightest approach in any part to the confluent radial structure of an *Iphiteon*. There are a few comparatively large acerate spicula dispersed amid the reticulations of the rigid skeleton; they are about four or five times the length of the dermal ones, and they are not frequently to be seen *in situ*. The connecting spicula are exceedingly beautiful objects. They are very variable in size and structure; and no two of them are alike in the mode of the foliations of their ternate radii, which are evidently modified to meet the necessities of the intermingling of their terminations, so as to secure a strong and elastic covering to the interstitial cavity beneath, and at the same time to produce abundant spaces for the porous areas of the dermis of the inhalant system. The structural aspect beneath the exhalant surface is very different from that of the inhalant one: here we find, as might be expected, large cavernous spaces for the reception of the effete streams from the rigid skeleton beneath, and, instead of the regular crypt-like form with its numerous minute pillars, we have elongated extensive spaces, the sides of which are, to a great extent, composed of irregularly disposed large acerate spicula imbedded in membranous structure; the shafts of the connecting spicula above are some of them connected with the parietes of the cavernous spaces,

while others appear to have no connexion with the tissues beneath them.

DACTYLOCALYX PRATTII, Bowerbank.

Sponge irregularly cup-shaped, pedicelled; surface even, slightly undulating. Oscula simple, small, dispersed, numerous. Pores congregated in areas formed by the distal terminations of the expando-ternate connecting spicula, numerous and large. Expansile dermal system—dermal membrane pellucid, furnished abundantly with minute entirely spined fusiformi-cylindrical spicula, short, frequently semilunate or angulated, irregularly dispersed. Connecting spicula irregularly furcated patento-ternate; radii slightly depressed, apices thin and expanded; ternate heads combining to form a dermal network. Enveloping membrane of the rigid skeleton abounding with the same minute spicula as those of the dermal membrane, and also with numerous separate flat fasciculi of long and slender acerate tension-spicula. Skeleton—rete compact; fibres smooth, or irregularly and slightly spinous; free terminations of fibres ramose, or abundantly tuberculated. Interstitial spicula acerate, long, slender, and frequently flexuous, mostly disposed in lines at right angles to the dermal surface. Interstitial membranes pellucid, furnished with the same form of retentive spicula as the dermal membrane.

Colour in the dried state, light brown.

Hab. East-Indies (*S. P. Pratt, Esq.*); off the island of Formosa (*Mr. Swinhoe*).

Examined in the dried state.

I am indebted to my late friend Mr. S. P. Pratt for the very interesting specimen under consideration. He stated that he was not quite certain of its locality, but he believed he had received it from his son, who was then in India, along with many other interesting marine specimens. The form of the sponge is that of an irregularly shaped cup, the rim of which is nearly an oblong, $4\frac{1}{2}$ inches long and $3\frac{1}{2}$ inches wide; and at one corner there is a depression of the margin, so as to form a lip to the cup of rather more than an inch in depth. The height of the cup in its present state is 4 inches. It has been broken away from its natural base; but, from the indications remaining, it is probable that it was elevated on a short pedestal. The margin of the cup is unequal in its thickness, varying from half an inch to a thin sharp edge. The specimen was evidently in a living state when taken from the sea, and it is still in an excellent state of preservation.

The oscula are simple orifices, without any especial defensive organs; they have the usual contractile membrane to open and close them in accordance with the necessities of the amimal. The greater portion of them were closed, while others were more or less open. Through one in the latter condition, in a slice from the surface mounted in Canada balsam, the surface of the rigid skeleton was seen, covered by the enveloping membrane, which was closely adhe-

rent to the outer portion of the rigid skeleton. When the back of this specimen was presented to the eye, this membrane was seen to be abundantly supplied with large, long, flat fasciculi of slender acerate tension-spicula. The minute short fusiformi-cylindrical spicula were as profusely scattered over the surface of this membrane as on the external dermal one.

The porous system, especially when we view its inner surface, is a most beautiful object for the microscope. The interlacing radii of the large patento-ternate connecting spicula form a beautiful series of round or oval areas, each containing from one to four or five large pores, the greater portion of which were open; and the dermal membrane on which they exist is beautifully freckled with innumerable minute, entirely spined fusiformi-cylindrical spicula, so closely packed together as to completely obscure the surface of the membrane, while the acutely conical shafts of the connecting spicula are seen at regular intervals projected towards the eye. A portion of this beautiful membrane is represented by fig. 8, Plate V.

The expansile dermal system is admirably displayed in this sponge by a section at right angles to the surface from almost any part of it. In some portions of such a section the dermal surface is closely pressed on to the surface of the rigid skeleton, while in others it is seen more or less separated from it, forming a cavity above it, into which the shafts of the connecting spicula are projected towards the surface beneath, as represented by fig. 6, Plate V.

The irregularly furcated patento-ternate connecting spicula are singular in their structure, and very characteristic of the species. No two of them are precisely alike, either in size or form; the eccentricity with which the radii are projected from the head of the shaft and the exceedingly variable mode of their ramifications are not a matter of chance, but they are evidently influenced by the necessities of their combinations with each other in forming the dermal network and porous areas; for if we view them *in situ*, we observe no points straying from the lines of combination, but the whole of their radii are locked together so as to form a compact but expansile network for the support of the dermal membrane and the formation of the porous areas.

The interstitial membranes filling the areas of the network of the skeleton are very translucent, and would scarcely be visible when immersed in Canada balsam, if it were not for the minute, short fusiformi-cylindrical spicula which are dispersed over their surfaces. These spicula, though exceedingly minute, afford very decisive specific characters. They are dispersed, more or less, over every part of the membranous structures, but more especially on the dermal membrane and the enveloping membrane of the rigid skeleton, which tissues they completely cover. They require a power of from 700 to 1000 linear to define their structural characters in a satisfactory manner. They vary considerably in size; one of the largest that I measured was $\frac{1}{2333}$ inch in length, and $\frac{1}{11666}$ inch in diameter; one of the smallest measured $\frac{1}{4666}$ inch in length, and $\frac{1}{20000}$ inch in diameter.